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verification of the law that "in summer, when the Sun runs highest, the full moon runs lowest."

The beautiful orb of June 17, 1894, was somewhat lower than the most southerly Moon of 1876.

When the occultation of stars is considered, even a few seconds of an arc are an important difference. The starry pathway being slightly different in successive revolutions, the various occultations are a conspicuous and interesting effect of lunar wanderings.

From time to time each of the major planets is cut off from view by the roving satellite of the Earth, but *Mercury* alone is ever encountered in the extremes of lunar latitude or Declination. *Aldebaran*, *Regulus*, *Antares*, *Spica*, the only stars of first magnitude within five degrees of the ecliptic, are generally occulted during each cycle to observers in some part of the Earth, for, on account of parallax, occultations depend on the latitude and longitude of observers. When, at long intervals, it is found that such stars as 49 and 54 *Auriga* and *e* and *Gamma Sagittarius* have been occulted, perhaps, a few times in succession, it is evidence that the queenly orb has speeded around the most northerly and southerly confines of her sidereal realm.

Like milestones the stellar lights mark her progress along the winding interlacing journey of years' duration which ends only to be re-commenced again and again for endless ages.

SAN FRANCISCO, CAL.

PLANETARY PHENOMENA FOR NOVEMBER AND DECEMBER, 1895.

BY PROFESSOR MALCOLM MCNEILL.

NOVEMBER.

Occultations. The Moon passes over the *Pleiades* twice, on November 3d in the early evening, and again on the night of November 30th, or rather, early in the morning on December 1st. On November 3d the Moon is just past full and the immersions will be at the bright limb and the emersions at the dark limb. The occultations at the end of the month occur just before the Moon is full, and the immersions will be at the dark limb. The

exact times of the occultations depend so much on the position of the observer that there is no use in giving them for any particular place, as they would be nearly useless for any other. At each series a number of the brighter stars will be occulted, and it is a phenomenon well worth observing for all who have telescopes of even small size.

The planets are for the most part best seen before sunrise in the morning, but most of them are too near the Sun to be very conspicuous.

Mercury is a morning star throughout the month, and reaches its greatest elongation on November 10th. It then rises about an hour and forty minutes before sunrise, and will be an easy object for naked-eye observation under good weather conditions. Except during the last few days of the month, it rises at least an hour earlier than the Sun. It moves rapidly eastward among the stars, and toward the close of the month comes into conjunction with *Saturn*, *Mars*, and *Uranus*, the closest being that with *Saturn* on November 20th. On the morning of that day, *Mercury* will be south of *Saturn* only a little more than the Moon's diameter. They approach still closer after sunrise in the United States.

Venus is the most brilliant in the morning sky, and reaches its greatest west elongation on November 29th, when it rises about four hours before the Sun. At the close of the month it is not far from the first magnitude star *Spica* (*Alpha Virginis*).

Mars passed conjunction with the Sun on October 11th, and is now a morning star, but cannot be easily seen, on account of its faintness and nearness to the Sun. At the end of November it rises nearly an hour and a half before the Sun, and a sharp eye may detect it in the morning twilight, if the air is very clear. On November 18th it passes only six minutes south of the third magnitude star *Alpha Libræ*.

Jupiter is getting around again to good position for those observers who do not care to sit up all night. By the end of the month it rises at about 9 P. M. It is in the constellation *Cancer*, and moves eastward about one degree from November 1st to November 25th, and then it begins to retrograde. It is a little south and east of "Præsepe," the "Bee-hive" cluster, in *Cancer*.

Saturn is in conjunction with the Sun on November 2d. By the end of the month it rises about two hours earlier, but it will not be at all conspicuous. It is in conjunction with *Mars* on

November 16th, when both are too near the Sun to be easily seen, and with *Mercury* on November 20th; at this time the conditions for visibility are a little better.

Uranus is in conjunction with the Sun on November 12th, and does not get far enough away to be seen.

Neptune is in the eastern part of the constellation *Taurus*.

DECEMBER.

The Sun reaches its greatest Southern Declination, and winter begins, at 5 P.M., December 21st, P. S. T.

Mercury is a morning star at the beginning of the month, rising not quite an hour before sunrise. It will be scarcely possible to see it, unless under exceptionally favorable weather conditions. It rapidly approaches the Sun and passes superior conjunction on December 20th, becoming an evening star.

Venus is still a morning star, and throughout the month keeps about the same distance away from the Sun, moving eastward among the stars at about the same rate as the Sun. It moves through the constellation *Virgo* from a position near *Alpha Virginis*, and through *Libra*, nearly reaching *Scorpio* by the end of the month.

Mars keeps its position relative to the Sun nearly unchanged, rising about an hour and a half to two hours before sunrise. On the morning of December 15th it passes about one degree south of the third magnitude star *Beta Scorpii*. It will be somewhat brighter than the star, about one magnitude, but it has not begun to brighten up very much yet.

Jupiter is beginning to get into comfortable position for evening observation; by the end of the month it rises before 7 P.M. During the month it retrogrades (moves westward) about two degrees in the constellation *Cancer*. It moves toward the fourth magnitude star *Delta Cancræ*, and at the end of the month passes to the south of the star at a distance about equal to the Moon's diameter.

Saturn is a morning star somewhat farther away from the Sun than it was during November. At the end of December it rises about four hours before sunrise. During the month it moves about three degrees eastward from a position about two degrees north of the third magnitude star *Alpha Libræ*. It is in conjunction with *Venus* on December 22d, *Venus* passing to the south of *Saturn* at a distance about equal to the Moon's diameter.

The minor axis of the rings is apparently a little greater than it was before conjunction, owing to the movement of the earth with reference to their plane.

Uranus is also a morning star, nearer the Sun than *Saturn* is, and is too low for naked-eye observation. It is moving eastward, and is several degrees east of its position during the summer.

Neptune is in the eastern part of the constellation *Taurus*. It is in opposition on December 8th.

EXPLANATION OF THE TABLES.

The phases of the Moon are given in Pacific Standard time. In the tables for Sun and planets, the second and third columns give the Right Ascension and Declination for Greenwich noon. The fifth column gives the local mean time for transit over the Greenwich meridian. To find the local mean time of transit for any other meridian, the time given in the table must be corrected by adding or subtracting the change per day, multiplied by the fraction whose numerator is the longitude from Greenwich in hours, and whose denominator is 24. This correction is seldom much more than 1^m. To find the standard time for the phenomenon, correct the local mean time by *adding* the difference between standard and local time if the place is west of the standard meridian, and *subtracting* if east. The same rules apply to the fourth and sixth columns, which give the local mean times of rising and setting for the meridian of Greenwich. They are roughly computed for Lat. 40°, with the noon Declination and time of meridian transit, and are intended as only a rough guide. They may be in error by a minute or two for the given latitude, and for latitudes differing much from 40° they may be several minutes out.

PHASES OF THE MOON, P. S. T.

		H.	M.	
Full Moon,	Nov. 2,	7	18	A. M.
Last Quarter,	Nov. 9,	3	6	P. M.
New Moon,	Nov. 16,	9	11	A. M.
First Quarter,	Nov. 23,	11	19	P. M.

THE SUN.

1895.	R. A.		Declination.	Rises.		Transits.		Sets.	
	H.	M.		H.	M.	H.	M.	H.	M.
Nov. 1.	14	26	— 14 27	6	31 A.M.	11	44 A.M.	4	57 P.M.
11.	15	6	— 17 27	6	42	11	44	4	46
21.	15	47	— 19 56	6	54	11	46	4	38
Dec. 1.	16	30	— 21 50	7	5	11	49	4	33

MERCURY.

Nov. 1.	13	38	— 8 52	5	23 A.M.	10	56 A.M.	4	29 P.M.
11.	13	54	— 9 16	5	2	10	33	4	4
21.	14	45	— 14 14	5	30	10	44	3	58
Dec. 1.	15	46	— 19 21	6	10	11	5	4	0

VENUS.

Nov. 1.	11	44	+ 0 42	2	57 A.M.	9	2 A.M.	3	7 P.M.
11.	12	14	— 1 1	2	53	8	52	2	51
21.	12	48	— 3 35	2	56	8	47	2	38
Dec. 1.	13	26	— 6 41	3	6	8	46	2	26

MARS.

Nov. 1.	14	0	— 11 46	5	55 A.M.	11	18 A.M.	4	41 P.M.
11.	14	26	— 14 7	5	50	11	4	4	18
21.	14	53	— 16 18	5	46	10	52	3	58
Dec. 1.	15	21	— 18 17	5	40	10	40	3	40

JUPITER.

Nov. 1.	8	43	+ 18 38	10	52 P.M.	6	2 A.M.	1	12 P.M.
11.	8	45	+ 18 30	10	16	5	25	12	34
21.	8	47	+ 18 27	9	39	4	47	11	55 A.M.
Dec. 1.	8	47	+ 18 29	8	59	4	8	11	17

SATURN.

Nov. 1.	14	33	— 12 44	6	31 A.M.	11	51 A.M.	5	11 P.M.
11.	14	37	— 13 6	5	57	11	16	4	35
21.	14	42	— 13 27	5	24	10	41	3	58
Dec. 1.	14	46	— 13 48	4	50	10	6	3	22

URANUS.

1895.	R. A.		Declination.	Rises.		Transits.		Sets.	
	H.	M.		H.	M.	H.	M.	H.	M.
Nov. 1.	15	9	— 17 20	7	24 A.M.	12	26 P.M.	5	28 P.M.
11.	15	11	— 17 31	6	48	11	50 A.M.	4	52
21.	15	14	— 17 41	6	12	11	13	4	14
Dec. 1.	15	16	— 17 51	5	35	10	36	3	37

NEPTUNE.

Nov. 1.	5	7	+ 21 24	7	6 P.M.	2	26 A.M.	9	46 A.M.
11.	5	6	+ 21 23	6	26	1	46	9	6
21.	5	5	+ 21 21	5	46	1	6	8	26
Dec. 1.	5	4	+ 21 19	5	5	12	25	7	45

PHASES OF THE MOON, P. S. T.

		H.	M.
Full Moon,	Dec. 1,	10	38 P. M.
Last Quarter,	Dec. 8,	11	9 P. M.
New Moon,	Dec. 15,	10	30 P. M.
First Quarter,	Dec. 23,	9	21 P. M.
Full Moon,	Dec. 31,	12	31 P. M.

THE SUN.

1895.	R. A.		Declination.	Rises.		Transits.		Sets.	
	H.	M.		H.	M.	H.	M.	H.	M.
Dec. 1.	16	30	— 21 50	7	5 A.M.	11	49 A.M.	4	33 P.M.
11.	17	13	— 23 1	7	13	11	53	4	33
21.	17	57	— 23 27	7	20	11	58	4	36
31.	18	42	— 23 6	7	23	12	3 P.M.	4	43

MERCURY.

Dec. 1.	15	46	— 19 21	6	10 A.M.	11	5 A.M.	4	0 P.M.
11.	16	51	— 23 8	6	51	11	31	4	11
21.	17	59	— 25 0	7	28	12	0	4	32
31.	19	10	— 24 34	7	58	12	32 P.M.	5	6

VENUS.

Dec. 1.	13	26	— 6 41	3	6 A.M.	8	46 A.M.	2	26 P.M.
11.	14	6	— 10 4	3	18	8	47	2	16
21.	14	49	— 13 26	3	33	8	50	2	7
31.	15	35	— 16 32	3	51	8	56	2	1

MARS.

1895.	R. A. H. M.	Declination. °	Rises. H. M.	Transits. H. M.	Sets. H. M.
Dec. I.	15 21	— 18 17	5 40 A.M.	10 40 A.M.	3 40 P.M.
II.	15 49	— 20 2	5 38	10 30	3 22
21.	16 19	— 21 29	5 34	10 20	3 6
31.	16 49	— 22 38	5 29	10 11	2 53

JUPITER.

Dec. I.	8 47	+ 18 29	8 59 P.M.	4 8 A.M.	11 17 A.M.
II.	8 45	+ 18 37	8 17	3 27	10 37
21.	8 43	+ 18 49	7 35	2 45	9 55
31.	8 39	+ 19 6	6 51	2 2	9 13

SATURN.

Dec. I.	14 46	— 13 48	4 50 A.M.	10 6 A.M.	3 22 P.M.
II.	14 51	— 14 6	4 16	9 31	2 46
21.	14 55	— 14 23	3 43	8 56	2 9
31.	14 58	— 14 38	3 8	8 20	1 32

URANUS.

Dec. I.	15 16	— 17 51	5 35 A.M.	10 36 A.M.	3 37 P.M.
II.	15 18	— 18 0	4 59	9 59	2 59
21.	15 21	— 18 8	4 23	9 22	2 21
31.	15 23	— 18 16	3 46	8 45	1 44

NEPTUNE.

Dec. I.	5 4	+ 21 19	5 5 P.M.	12 25 A.M.	7 45 A.M.
II.	5 2	+ 21 18	4 21	11 40 P.M.	6 59
21.	5 1	+ 21 16	3 40	11 0	6 20
31.	5 0	+ 21 15	3 0	10 20	5 40